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Sample assessment material

LEVEL 3 ALTERNATIVE ACADEMIC QUALIFICATION CAMBRIDGE ADVANCED NATIONAL IN

ENGINEERING

Extended Certificate H127

For first teaching in 2025

Unit F131: Materials science and technology

Version 1.0 (June 2024)

Introduction

This is Sample Assessment Material (SAM) which has been produced for the qualification OCR Level 3 Alternative Academic Qualification Cambridge Advanced National in Engineering.

The SAM is an example exam paper that we publish alongside a new specification to help illustrate its intended style and structure when a qualification is first launched. We wanted to share the story of our assessment approach with you so when you look through the paper you will find we have pointed out certain features and explained the decisions we have made.

Resources to help support in teaching different areas of content can be found on the Cambridge Advanced National in Engineering webpage under 'Planning and teaching'.

Our exam papers are developed with our accessibility principles in mind. The Understanding the assessment guide tells you a little more about the principles and rationale underpinning our approach for the qualifications. The 'Command Words' are in both the Understanding the Assessment guide and the specification. These tell you what we mean by each command word and how students should approach the question and understand its demand.

Appendix B of the specification: Command Words, gives detail about what is expected of each command word that will be included in exams and mark schemes. You can include teaching around the expectations of these as part of your teaching.

You said, we did

During the development of this qualification, we talked extensively with teachers, subject experts, higher education institutions and our senior assessment teams to influence its structure, content and assessment materials. We then shared our final materials with teachers to make sure that they met their needs.

You told us that you wanted a general engineering qualification to help students progress to all types of engineering and product design undergraduate degrees. We have done this by ensuring the mandatory units cover, as far as possible, both mechanical engineering and electrical/electronic engineering as well as material properties content and assessment.

You told us that you wanted the external assessment to be similar to the external assessment in the current Cambridge National in Engineering qualifications. We have tried to do this by using a familiar tone and style of questioning.

You told us that you wanted fewer exams, so we have reduced the number of mandatory examined units to two.

You told us to keep the exams as short as possible but retain time to allow students to read the scenario and respond to questions. We have done this by reducing the number of available marks to 50 and setting the duration of the exam to 1 hour 15 minutes.

You told us that scenarios used within external assessment should be accessible and easy for students to understand. We have therefore tried to use common engineering applications, using everyday objects and products where possible. Scenarios are kept as short as possible, and diagrams are used where it is appropriate to do so.

Examples of comments received are placed against the relevant sections/questions.

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All students will sit the exam at the same time on the same day.

The time allowed is designed to give students approximately one minute per mark plus reading time.

If students require additional answer space, lined paper may be available at the end of the answer booklet in a live question paper. Remember the question number(s) must be clearly shown.

Each exam will ask at least one question from each Topic Area in the unit. Questions will not necessarily be in the same order as the teaching content. Students should answer all questions.

The exam will always have 50 marks and consist of two sections. Section A will have a total of 20 marks, and Section B will have a total of 30 marks.

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Level 3 Alternative Academic Qualification Cambridge Advanced National in Engineering

H127 Unit F131: Materials science and technology

This exam will always be set and marked by us. Exams will be available in January and June each year. Students can resit this unit and the best result will be used to calculate the certification result.

Sample Assessment Material (SAM)

Time allowed: 1 hour 15 minutes

No extra materials are needed.

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

Date of birth | D | D | M | M | Y | Y | Y | Y |

INSTRUCTIONS

- Use black ink.
- Write your answer to each question in the space provided. You can use extra paper if you need to, but you must clearly show your candidate number, the centre number and the question numbers.
- In the live exam there might be lined pages at the end of the question paper for you to use if you need extra space. Remember, you must clearly show the question numbers.
- Answer **all** the questions.

INFORMATION

- The total mark for this paper is **50**.
- The marks for each question are shown in brackets **[ ]**.
- This document consists of **12** pages.

ADVICE

- Read each question carefully before you start your answer.

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There are a total of 20 marks available in Section A, which will consist of mandatory low tariff questions about material properties, types, and processes.

There will be 5 multiple choice questions each worth one mark. In addition, there will be a number of short answer questions, each worth 1, 2 or 3 marks, totalling 10 marks.

These allow us to assess the following Performance Objectives:

- PO1 – Show knowledge and understanding
- PO2 – Apply knowledge and understanding
- PO3 - Analyse and evaluate knowledge, understanding and performance

The questions in Section A will sample content from across all Topic Areas.

Section A

For questions 1 to 5 put a tick (✓) in the box next to the **one** correct answer for each question.

1 Which material property means the ability of a material to resist being scratched, eroded or abraded?

Tick (✓) **one** box.

- Corrosion resistance ☐
- Hardness ☐
- Malleability ☐
- Toughness ☐

[1]

For multiple choice questions students should put a tick (✓) in the box to show their response for multiple choice questions

2 Which of these is a thermoplastic polymer?

Tick (✓) **one** box.

- Epoxy resin ☐
- Polyester resin ☐
- Polypropylene ☐
- Urea formaldehyde ☐

[1]

3 Which of these describes how an increase in the pressing force during sintering affects the properties of a ceramic component?

Tick (✓) **one** box.

- It decreases the density of the component ☐
- It decreases the strength of the component ☐
- It increases the density of the component ☐
- It increases the mass of the component ☐

[1]

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4 Which of these would increase the risk of a metal component failing due to creep?

Tick (✓) **one** box.

- A decrease in the applied load ☐
- A decrease in the toughness of the material ☐
- An increase in the cross-sectional area of the component ☐
- An increase in the operating temperature ☐

[1]

The number of marks assigned to a question will always be given at the end of the question and will always be right aligned.

5 Which of these materials has a smart property that does **not** involve a change in its physical dimensions?

Tick (✓) **one** box.

- Photochromic pigment ☐
- Piezoelectric crystals ☐
- Quantum tunnelling composite ☐
- Shape memory alloy ☐

[1]

Multiple choice questions will always have four response options listed in alphabetical or numerical order. The four response options will consist of the correct answer and three distractors.

6 Explain the difference between physical properties and mechanical properties.

.....

.....

.....

.....**[2]**

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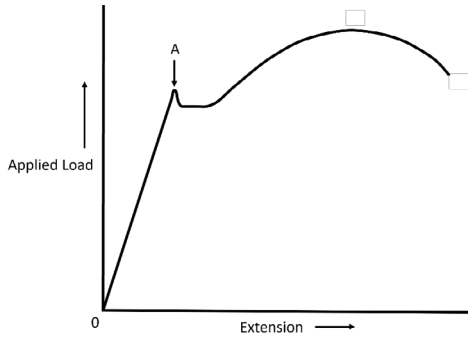
7 This is a load-extension graph from a tensile test carried out on a low carbon steel.



(a) Identify the characteristic shown by the letter **A**.

..... **[1]**

(b) Explain the importance of using a load-extension graph when deciding if a material is suitable for an engineering application.

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.....**[3]**

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This “identify” question assesses PO1 - show knowledge and understanding.

Sometimes we do not accept a response if it is too generic or not specific enough. For example, here we would not award credit if the word ‘strength’ was given on its own.

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8 Explain **one** difference between the heat treatment processes of normalising and annealing.

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.....**[2]**

9

Paint is to be applied to a large outdoor steel footbridge to prevent corrosion.

(a)

Explain why this type of corrosion prevention would be most suitable to use.

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.....

.....**[2]**

(b) State **three** types of corrosion prevention, other than paint, that could be used to protect steel.

1. .....

2. .....

3. .....

[3]

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The number of points needed will always be written as a word in bold

The number of lines given for a question indicate the approximate length of the answer required.

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There are a total of 30 marks available in Section B. Questions in this section will be more in-depth and based on engineering contexts or scenarios.

Question types include:

- Three structured questions consisting of a number of linked parts.
- One extended question with levels of response marks scheme.

These allow us to assess the following Performance Objectives:

- PO1 – Show knowledge and understanding
- PO2 – Apply knowledge and understanding
- PO3 – Analyse and evaluate knowledge, understanding and performance.

10 Explain **two** different ways that the circular economy could be implemented for a toaster.

1 .....

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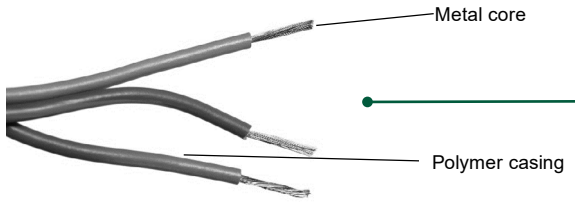
2 .....

.....

[2]

Section B

11 Electrical wires, such as those shown below, have a metal core and a polymer casing.



Images will always be greyscale.

(a) Identify **one** suitable metal to use for the core.

Give **two** reasons for your choice.

Metal: .....

Reason 1: .....

.....

Reason 2: .....

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[3]

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(b) Describe the bonding mechanism within the metal core.

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..... **[4]**

This question assesses PO2, apply knowledge and understanding, and student responses must be applied to the electrical wire casing.

(c) Explain why the electrical wire casing is made from a thermoplastic polymer rather than a thermosetting polymer.

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.....**[2]**

12 A manufacturer of high-performance racing bicycles is changing the material used to make the frames from a metal alloy to carbon reinforced polymer (CRP) composite material.

Where contexts are used, information will be concise and specific to the question.

(a) Explain the difference between a metal alloy and a composite material.

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.....**[2]**

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Appendix B in the specification contains a glossary of Command Words which will be used in our exams. The glossary tells you what we mean by each command word.

(b) Explain **one** reason why a designer may prefer carbon reinforced polymer (CRP) to a metal alloy as the material for the bicycle frames.

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.....**[2]**

(c) Describe the lay-up process that would be used to make the bicycle frame from carbon reinforced polymer (CRP).

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.....**[4]**

This is an example of a medium tariff questions. These are typically 3-6 marks where students will provide a shorter style extended response.

We will use medium tariff questions to assess a range of performance objectives. They will enable students to show and/or apply knowledge and understanding and in some cases use analytical skills.

(d) Explain how the alignment of the fibre reinforcement will affect the properties of the carbon reinforced polymer (CRP) when used in the bicycle frame.

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.....**[4]**

As a general rule, the demand of questions will increase as you progress through each section of the exam paper.

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13 Car headlights have a transparent lens on the front. These lenses could be made from glass or polymer.

Discuss which of these materials is the most sustainable choice for this application.

In your answer you **must** write about:

- the **advantages** of using each material for a car headlight lens.
- the **disadvantages** of using each material for a car headlight lens.
- **which** material you would recommend **and** the reasons why.

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The exam will have one level of response (LOR) question that needs an extended written response. The question topic may be drawn from any relevant aspect of the unit teaching content.

Extended response questions give students a real opportunity to show examiners the extent of their knowledge and understanding of the subject.

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10

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.....**[9]**

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Indicates to students there are no more questions to answer.

END OF QUESTION PAPER

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